

EXAMINING THE SCIENTIFIC PRODUCTIVITY OF AUTHORS IN ALTMETRICS

RESEARCH: A STUDY USING LOTKA'S LAW

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ABSTRACT

The fundamental aim of this study was, to analyze the application of Lotka's law to the research publication, in the field of Altmetrics. The data related to alt metrics were extracted from web of science database, which is a scientific, citation and indexing service, maintained by Thomson Reuters. A total of 215 research publications were published by the researchers, in the field of Alt metrics. The study found out that, the Lotka's inverse square law is not fit for this data. The study also analyzed the Prolific authors, Authorship pattern and the Degree of Collaboration

KEYWORDS: Lotka's Law, Web of Science & Degree of Collaboration etc

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INTRODUCTION

One of the most important areas in bibliometric research is the solicitation of bibliometric laws to research publications. The three most commonly used laws in bibliometrics are - Lotka's Law of Scientific Productivity, Bradford's Law of Scatter, and Zipf's Law of Word Occurrence. The Lotka's law is concerned with the frequency of publication by authors in a given field. Bradford's law deals with the scattering of research publication in different journals, and finally Zipf's law relates to the frequency of word applications, in research publications. In this study, the Lotka's Inverse square law is applied to the Alt metric's research publications around the globe, to identify the frequency of publication by authors in Alt metrics.

ALTMETRICS

The term "Altmetrics" was coined by Jason Priem, in the year 2010. Altmetrics are metrics and qualitative data that are corresponding to conventional, citation-based metrics. Altmetric tracks a range of sources, to capture and collate this activity, helping you to monitor and report on the attention surrounding the work you care about. They can include peer reviews on Faculty, citations on Wikipedia and in public policy documents, discussions on research blogs, mainstream media coverage, bookmarks on reference managers like Mendeley, and mentions on social networks, such as Twitter. Sourced from the Web, Altmetrics can tell you a lot about, how often journal articles and other scholarly outputs like datasets are discussed, and used around the world. For that reason, Altmetrics have been incorporated into researchers' websites, institutional repositories, journal websites, and more.

AIM AND OBJECTIVES

The following aim and objectives were framed by the researchers for the present study

AIM

The main aim of this research is to analyse the application of Lotka's law to Altmetric research publications

EXPLICIT OBJECTIVES

- To examine the year wise publication of Altmetric research publications.
- To find out the prolific authors in the field of Altmetrics
- To analyse the authorship pattern and degree of Collaboration, in Altmetric research output

REVIEW OF RELATED LITERATURE

Shilpa Dhoble (2017) analysed the applicability of Lotka's law in Mustard research and found out that, the collaboration of more number of authors per article, dominates in the publications activities, in this research. There are only 7.1% single authored papers. In few cases, there were very high numbers of collaborations. The researchers also stated that even after 90 years, Lotka's law is still applicable and the trend has not changed. Rajani, S. and Ravi B (2016) in their study on the applicability of Lotka's law and authorship pattern, in the field of mathematical science explained that, the multiple authors are predominant, as compared to single authorship. The research publications of Digital Architecture were not satisfying to the Lotka's inverse square law (Ranganathan C and Dr. R. Balasubramani 2013).

METHODS AND PROCEDURES

The study adopted an analytical method, where the records are already available in the Citation and indexing database namely, Web of science (WoS). WoS is a citation and indexing database, maintained by Thomson Reuters. It consists of four citation Indexes namely Science Citation Index (SCI), Social Science Citation Index (SSCI), Arts and humanities Citation Index (A&HCI) and Emerging Source Citation Index (ESCI) (Balasubramani & Murugan, 2011). The records relating to Altmetrics were extracted, using the following search strategy.

Title-Abs-Key ("Altmetrics")

The data was collected on April 1, 2017 and the extracted data were tabulated accordingly, using Microsoft excels and detailed analysis, focusing on the objective.

FORMULAE

The following formulas were used in the present study

Lotka's Inverse Square Law of Scientific Productivity

It was proposed by Alfred Lotka in 1926

$$1/n^2$$

Where

1 = Number of authors making only single contribution

n = Number of contributions (1, 2, 3.....)

Degree of Collaboration

The formula suggested by Subramanyam (1983)

It is expressed as

$$C = \frac{Nm}{Nm + Ns}$$

- Where, C is the degree of collaboration in a discipline. Nm is the number of multi-authored research papers in the discipline published during a year.

Ns are the number of single authored papers in the discipline published during the same year. Using this formula, the degree of collaboration is determined.

Chi Square – Test

$$\chi^2 = \sum (\text{Observed} - \text{Expected})^2 / \text{Expected}$$

ANALYSIS

A total of 215 records were published in the field of Altmetrics all over the globe, from the bibliographical details were tabulated and the following analysis were carried out.

PUBLICATION YEARS

Table 1: Year Wise Distribution of Publication

S. NO	PUBLICATION YEAR	RECORDS	PERCENT	CITATIONS
1	2012	2	0.9	40
2	2013	12	5.6	266
3	2014	30	14.0	413
4	2015	61	28.4	298
5	2016	97	45.1	115
6	2017	13	6.0	5
	TOTAL	215	100	1137

Table 1, shows the year wise publications in Altmetric research output around the globe, which are indexed in web of science. It is evidently noticed that, Altmetrics is still an emerging area around the world; hence the publications start from the year 2012. Based on the data presented in the above table, it is seen that, the highest number of publications in the year 2016 with 97 records, contributing to 45.1% of total publication, which is followed by the year 2014 with 61 records, contributing to 28.4% of total publication. So far, in the year 2017 (till April 1) only 13 records were published and it is expected that, the research papers will increase by the end of the year and also out number their previous years.

PROLIFIC AUTHORS

Table 2: Ranking of Top Ten Authors in Altmetric Research

S. NO	AUTHORS	RECORDS	DEPARTMENT	TOTAL CITATIONS	H-INDEX
1	Thelwall, M	22	Wolverhampton Univ, School of Technology, Wolverhampton, England	387	10
2	Bornmann, Lutz	19	Division for Science and Innovation Studies, Munich, Germany	109	6
3	Haunschild R	12	Max Planck Institute for Solid State Research, Stuttgart, Germany	31	3
4	Haustein S	8	University of Montreal, EcoleBibliothecon & SciIn format, Montreal, PQ, Canada	244	6
5	Kousha K	7	Wolverhampton University, Statistics Cybermetr Research Group, School of Mathematics & Computer Science	50	5
6	Lariviere V	5	Dalian University of Technology, Faculty of Humanities & Social Science	24	3
7	Gorraiz J	5	University of Vienna, Bibliometric Department, Austria	11	2
8	Costas R	5	Leiden University, Centre for Science & Technological Studies, Netherlands	116	4
9	Zahedi Z	4	Leiden University, Centre for Science & Technological Studies, Netherlands	95	3
10	Peters I	4	Leibniz Information Centre for Economics, Germany	50	3

Table 2, depicts the contribution of top ten authors in Altmetrics research output. It is observed from the table that, Thelwall. M from the School of Technology, Wolverhampton, England has published the maximum number of publications with 22 records each, having 387 citations and an h-index of 10, which is followed by Bornmann, Lutz from the Division for Science and Innovation Studies, Munich, Germany with 19 records, with 109 citations and an h-index of 6.

AUTHORSHIP PATTERN

Table 3: Authorship Pattern in Altmetric Research

AUTHORSHIP PATTERN	RECORDS
SINGLE	84
DOUBLE	58
TREBLE/TRIPLE	28
QUADRUPLE	24
PENTADRUPLE	9
HEXATRUPLE	7
SEPTUPLE	3
OCTUPLE	0
NONUPLE	2
DECUPLE	0
TOTAL	215

Table 3 provides the Authorship Pattern of Altmetric research publications around the globe. It is clearly seen from the table that, majority of the publications (131) are contributed by single authors, as compared to multi-authored papers. It is also inferred from the table that, there are no Octuple and Decuple authored papers, in Altmetric research.

DEGREE OF COLLABORATION

The degree of collaboration is defined as the ratio of the number of collaborative research papers, to the total number of research papers in the discipline, during a certain period of time. The formula suggested by Subramanyam (1983) was used.

Thus, the degree of collaboration $C = 131/215 = 0.61$, which indicates that, the ratio of collaborative papers are greater when paralleled to single authored papers.

LOTKA'S LAW OF AUTHOR PRODUCTIVITY

In 1926, Alfred J. Lotka proposed an inverse square law, relating to scientific papers to the number of contributions, made by each author. Lotka's Law describes the frequency of publication by authors, in a given field. It states that, the number of authors making contributions is about $1/n^2$ of those making one; and the proportion of all contributors, that make a single contribution, is about 60 percent". This means that out of all the authors in a given field, 60 percent will have just one publication, and 15 percent will have two publications ($1/2^2$ times. 60), 7 percent of authors will have three publications ($1/3^2$ times. 60), and so on. According to Lotka's Law of scientific productivity, only six percent of the authors in a field will produce more than 10 articles.

The Lotka's law is applied to author's productivity, is presented in the below Table. From the table it is evident that, the observed percentage of authors varied from the expected percentage of authors, as predicted by applying Lotka's equation. The Chi-square test was further applied to compare the observed values with the expected value of author's productivity according to Lotka's law. The calculated Chi-square value (97.51) was more than the Table Chi-square value i.e. 16.919, at a degree of freedom of 9, level of significance, = 0.05. Here the Chi-square value was highly significant and Lotka's law was not applicable to this data.

Table 4: Lotka's Law on Altmetric Research Publications

No. of Contributions (N)	Observed No. of Authors (a_n)	Observed of Authors $\frac{100 * a_n}{a_1}$	Expected no. of Authors (p) $a_n = \frac{a_1}{n^2}$	Expected % of Author Predicted by Lotka ($100/n^2$)	$(a_n - p)^2 / p$
1	323	100(87.29)	323	100	0
2	27	8.35(7.29)	81	25	36
3	6	1.85 (1.63)	36	11.11	25
4	5	1.54 (1.35)	20	6.25	11.25
5	4	1.23 (1.09)	13	4.00	6.23
7	1	0.30 (0.27)	9	2.77	7.11
8	1	0.30 (0.27)	7	2.04	5.14
12	1	0.30 (0.27)	5	1.56	3.2
19	1	0.30 (0.27)	4	1.23	2.25
22	1	0.30 (0.27)	3	1.00	1.33
TOTAL	370	(100)	501		97.51

OBSERVED NUMBER OF AUTHORS

The 322 authors have contributed one paper, 27 authors have two, 6 authors have three, 5 authors have four, 4 authors have five, 1 authors have seven, 1 authors have eight, another 1 author have twelve, 1 author have nineteen and 1 authors have twenty two papers to their credit.

OBSERVED PERCENTAGE OF AUTHORS

Observed Percentage of Authors is calculated using the formula $100 \cdot a_n / a_1$

$a_n = 323$; $a_1 = 323$ (for the first row in f)

By substituting the values in the formula we get:

$$100 \cdot 323 / 323 = 100$$

In the same way the other values are calculated.

EXPECTED NUMBER OF AUTHORS (P)

Expected number of Authors is calculated using the formula $a_n = a_1 / n^2$

$a_1 = 323$; $n = 1$ (for the first row in f)

By substituting the values in the formula we get:

$$323 / 1^2 = 323$$

Similarly, the other values are calculated.

EXPECTED PERCENTAGE OF AUTHORS

Expected percentage of Authors is calculated using the formula $100 / n^2$

$N = 1$ (for the first row)

By substituting the value in the formula we get:

$$100 / 1^2 = 100$$

Correspondingly, the remaining values are calculated.

CHI- SQUARE TEST

Chi – Square model is applied using the formula $(a_n - p)^2 / p$

$a_n = 323$; $P = 323$ (for the first row)

By substituting the values in the formula we get:

$$(323 - 323)^2 / 323 = 0$$

Accordingly, the further values are calculated.

DEGREES OF FREEDOM (DF)

DF is calculated using the formula $(r-1)(c-1)$

r – No. of Rows ; c – No. of columns

Here, $r = 10$; $c = 2$

By substituting the values in the formula we get:

$$(10-1)(2-1) = 9$$

The table value of 9 at 0.05 level of significance 16.919

CONCLUSIONS

The application of quantitative measures to research publications will yield to the contribution of individual researchers, publications etc. This study focussed on the application of Lotka's law, to Altmetric research publications across the globe and sufficiently found out that, the inverse square law proposed by Lotka was not applicable to this data, indexed in web of science. In other words, it can be concluded that, Lotka's law was not for this study.

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